

ATTACHMENT B

REMARKS

By this amendment, Applicants have canceled without prejudice Claims 1-6 and have amended Claim 7 to incorporate the subject matter of canceled Claim 1. For reasons as stated in detail below, upon entrance of the present amendments, Applicants submit that the present claims are patentable over the cited prior art, and that the present application will be placed in condition for immediate allowance.

In the Official Action, the Examiner rejected Claims 1-6 under 35 U.S.C. § 102 as being anticipated by Logsdon US Patent 4,876,402. Without addressing the arguments of the Examiner, which would be contested at such time as Applicants file a divisional application on this subject matter, this rejection has become moot by virtue of the present amendments canceling Claims 1-6.

In the Official Action, Claims 7, 8 and 10 were rejected under 35 U.S.C. § 103 on the basis of JP 6-22870 in view of the Logsdon patent, and Claims 9, 11 and 12 were rejected under 35 U.S.C. § 103 on the basis of the combination of references cited against Claims 7 and 10, further in view of EP 1192981. These rejections, insofar as applied to the claims as amended, are respectfully traversed for the reasons as stated below.

(1) The Present Invention

The present invention is directed to a hydrocarbon desulfurization method which is characterized in that a hydrocarbon raw material is desulfurized in the presence of hydrogen with using the specific desulfurizing agent (i.e., the agent obtained by the method of the original claim 1).

According to the hydrocarbon desulfurization method of the present invention, highly desulfurized hydrocarbons can be obtained easily and in a stable manner over a long period of time by using small quantities of the agents. Consequently, even in cases where catalysts that are susceptible to sulfur poisoning are used in the steam reforming of hydrocarbon raw material, etc., the deleterious effects of sulfur can be eliminated to a great extent; e.g., sulfur poisoning can be virtually completely prevented, etc.

This fact is clear from the examples of the present invention. For instance, the operating time of Examples 1-5 is 4000-8000 hours or more. On the other hand, the operating time of Comparative Examples 1-3 is 1260-2200 hours at most.

In addition, there is a serious impediment to using iron type desulfurizing agents or nickel type desulfurizing agents (i.e., conventional agents) as is in the desulfurization of steam reforming processes. Specifically, desulfurization in ordinary steam reforming process is performed in the presence of hydrogen, and this hydrogen is supplied by recycled gas from the outlet port of a reformer. This recycled gas contains CO and/or CO₂ as well as hydrogen. Accordingly, in the presence of an iron type or nickel type desulfurizing agent, a reaction of the hydrogen with CO and CO₂ (methane forming reaction) occurs, which is accompanied by the problem of a large amount of heat generation. In contrast, the heat generation can be avoided or suppressed according to the method of the present invention.

By comparing the results shown in Example 6 and Comparative Example 5, it is evident that no rise in temperature due to a methane forming reaction is seen in Example 6 whereas a temperature rise caused by a methane forming reaction in

Comparative Example 5. Though the numerical value of the temperature rise is not mentioned in the present specification, the value is about 20-30°.

Thus, (1) the long period of the operating time as well as (2) the effective suppression of heat generation can be achieved by the method of the present invention.

(2) The Differences Between the Cited References and the Present Claims

Logsdon (US 4,876,402 or "the '402 patent")

The '402 patent discloses an improved vapor phase catalytic hydrogenation of aldehydes to the corresponding alcohols wherein the improvement comprises employing a copper oxide-zinc oxide catalyst impregnated with a selectivity enhancer selected from the group consisting of an alkali-metal, transition metal and mixtures thereof.

However, the '402 patent is totally silent about using the catalyst for "a hydrocarbon desulfurization". As mentioned before, the '402 patent merely discloses an improved vapor phase catalytic hydrogenation of aldehydes to the corresponding alcohols. Needless to say, this reaction is totally different from a "a hydrocarbon desulfurization".

In other words, there is no motivation to use the agent for a hydrocarbon desulfurization in the '402 patent at all.

Therefore, those skilled in the art would not expect the use of the agent for "a hydrocarbon desulfurization" and the advantages of (1) the long period of the

operating time plus (2) the effective suppression of heat generation based on the teachings of the Logsdon '402 patent.

JP 06-22870

JP 06-22870 relates to the desulfurization of feedstock hydrocarbon for fuel cell. However, this reference merely discloses a desulfurizing agent consisting of copper, nickel and zinc oxide. The agent disclosed in JP 06-22870 is quite different from the agent of the present invention because the method for preparing the agent of differs from that of the present invention.

In Example 1 of JP 06-22870, the agent was produced from a mixed aqueous solution containing not only copper nitrate and zinc nitrate but also nickel nitrate. When the solution contains nickel, the desired agent and the excellent desulfurizing property cannot be obtained.

This fact is clear from the Comparative Example 5 in the present specification. According to the Comparative Example 5, the CO concentration in the outlet gas was 1.5 vol.%, and a temperature rise caused by a methane forming reaction was observed.

Thus, no description or suggestion is found in JP-06-22870 about how to obtain the advantages of above (1) and (2) of the present invention.

EP 1192989

EP 1192989 discloses a method of desulfurization of town gas not containing hydrogen, characterized in that the desulfurizing is carried out by adding hydrogen to

the town gas, and by using copper-zinc desulfurizing agent prepared by co-precipitation method.

However, there is nothing disclosed in EP 1192989 which is about using iron or nickel for a hydrocarbon desulfurization (see claims 1-8, examples of EP 1192989). The advantages (1) and (2) cannot be achieved unless iron or nickel is contained in a desulfurizing agent at least. This is clear from Comparative Examples 1 and 6, for instance.

EP 1192989 fails to teach or even suggest the agent essentially required in the present invention and the advantages of (1) and (2) realized by using the agent.

There is further no motivation to conceive the hydrocarbon desulfurization method of the present invention stems from a combination of the Logsdon '402 patent, which is totally silent about a hydrocarbon desulfurization, with JP 06-22870 or EP 1192989 which merely discloses an agent different from the present invention.

Moreover, those skilled in the art would not expect (1) the long period of the operating time as well as (2) the effective suppression of heat generation which occurs in the cited references.

Therefore, the hydrocarbon desulfurization method (claims 7-12) of the present invention is patentable over the Logsdon patent, JP 06-22870 and EP 1192989, either singly or in combination.

Accordingly, the present claims 7-12 are clearly not anticipated or made obvious by the cited references and are thus patentable over the cited references. The Examiner's rejections on the basis of these references are thus respectfully traversed and should be withdrawn.

In light of the amendments and arguments as set forth above, Applicants submit that upon entrance of the present amendments, the present application overcomes all prior rejections and has been placed in condition for allowance. Entrance of the amendment and allowance of the application is thus respectfully requested.

END REMARKS